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Effect of Days Open on Lactation Production

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EFFECT OF DAYS OPEN

ON LACTATION PRODUCTION

BY

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This thesis is approved as a creditable and independent investigation by a candidate for the degree, Master of Science, and is acceptable as meeting the thesis requirements for this degree. Acceptance of this thesis does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Thesis Advisor Date

Head, Dairy Science Department Date

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Accurate evaluation of dairy production records is essential if dairymen are to establish and maintain profitable dairy herds and efficient culling programs. Improper record evaluation may result in saving breeding stock that otherwise might be eliminated.

Many factors may influence the validity of individual production records. Adjustment factors, currently in use by the United States Department of Agriculture (USDA) for sire and cow evaluations, are generally accepted as removing the majority of these influences. Consequently, these factors are invaluable to practical dairymen. The adjustment factors, suggested by McDaniel, et al. (24) in 1967, take into account the geographical location, season of calving, breed, age at calving, and milking frequency for both milk and fat, independently of one another. These factors are regarded as being adequate in removing variation arising between herdmates.

Reproductive efficiency is of economic importance to dairymen. The necessity for regular calving is vital in an efficient dairy operation in order to maintain longevity and maximize lifetime net returns. Calving interval and days open prior to conception are related measures of reproductive efficiency which may assist in production record evaluation. Days open prior to conception actually determine the calving interval, assuming a constant gestation length; consequently, examination of days open would appear more applicable in evaluation of reproductive influences on production. It must be realized that certain environmental factors, such as careful and skillful observation of animals, type of housing system, and nutritional practices, may enter into relationships between production and reproductive efficiency and therefore, these factors must be accounted for in the analysis of data.

This study was undertaken to determine the relationships which exist between days open prior to conception and lactation production in South Dakota Holstein herds. The specific objectives of the study were as follows:

1. To determine the influence of days open on 305 day production.
2. To develop adjustment factors for days open, if warranted.
3. To determine phenotypic correlations between days open and production.

REVIEW OF LITERATURE

Investigations into the effects of gestation on accompanying lactation production were especially numerous in the 1920 era. Several studies (3,10,14,28,29) agreed that following conception, a slight depression in yield generally results. The depressed yield level is then maintained for a period of about 20 weeks, at which time a sharp decline is observed.

Brody, et al. (3), who checked barren cows against cows bred three or four months after parturition, offered the explanation that the nutrient requirement for fetal growth by the gestating cow reduces the nutrient supply usually available to the mammary gland by an equivalent amount. They suggested that the explanation was substantiated because the decline in milk yield and the weight increase of the gestating cow were nearly parallel. Also, differences in milk yield between pregnant and barren cows amounted to about 450 pounds, which was believed to contain a dry matter amount capable of growing and supporting the life processes of the fetus. Ragsdale, et al. (27) further suggested that in the early stages of pregnancy, the embryo is so relatively small in comparison to the body weight of the gestating cow, that nutrient requirements are insignificant. Total milk yield reduction of 480 to 800 pounds was suggested as being caused, at least in part, by demands of the fetus.

In 1926, Gaines and Davidson (10) studied 4,522 production records from the American Guernsey Cattle Club. Two suggestions were offered as possible explanations of the milk decline associated with advancing pregnancy; first, a decrease may be due to nutrient requirements of the fetus, and secondly, a hormone is produced which enters the circulatory system during pregnancy and may act as an inhibitor of milk secretion. In a summarization of the study, the researchers suggested that the influence of pregnancy on milk production is caused directly by the existing hormone rather than due indirectly to fetal requirements. Other studies (2,14,28) agree with this hormone secretion explanation offered by Gaines and Davidson.

Sanders (29) found variation from breed to breed and from high to low producing cows. He suggested that the decline in yield associated with gestation was possibly due to the preparation of the mammary gland for the following lactation, which apparently begins quite early in pregnancy and is definitely intensified about 20 weeks following conception.

In 1943, Ludwick, et al. (20) gave further suggestions as to a possible explanation for the milk yield decline. They suggested that the initial change in production following conception may be the result of the animal adjusting to the effect of the retention of the corpus luteum of pregnancy. They also suggested that especially in advanced stages of pregnancy, placental hormones may affect production yields, and also increased blood supply to the growing fetus may reduce the supply to the mammary gland, thus resulting in decreased production.

Turner, et al. (38) found that there was regularity in the decline of milk yield with advancing lactation. They expressed each month's production after the second month in a constant percentage of the preceding month's production. In studies with barren Guernsey cows, where the pregnancy factor is eliminated, each month's production was found to be about 94 percent of the preceding month's production. Cows which were not barren showed a slightly larger percentage decrease the last two or three months, due to advancing pregnancy.

Gowen (13) derived equations from partial correlation coefficients which could be used to predict lactation milk yield from monthly milk yield and pregnancy duration. The data showed that the effect of carrying a calf is a slight, but insignificant drain on milking capacity ranging from 400 to 600 pounds of milk. In addition, the influence of the length of time the calf is carried was found to be least for the young and very old cows, and greatest at five years of age.

Gaines and Davidson (10) found average decreases in yield of 2.5 pounds and 256 pounds of fat-corrected-milk (FCM), respectively, for the first five months of pregnancy and for 9.2 months of pregnancy.

In a 1952 study, Erb, et al. (7) investigated production on 82 Holstein, Guernsey, and Jersey cows. During the first 100 days of pregnancy, milk and FCM declined at essentially the same rate. However, during the next 80 days, FCM and milk fat yield declined at a slightly slower rate and milk yield declined about one-third faster. Finally, from 181 to 223 days of pregnancy, the decline in production was 3 to 4 times faster than the previous period. A curve of the lactations of 10 barren cows was observed for 365 days and revealed that there was a tendency for milk yield rate to decline after 330 days. This is contrasted to the accelerating rate of decline in those cows pregnant for more than 180 days. The researchers suggested that the decline in lactation production followed a cyclic pattern after conception, much like that observed for estrual cycles.

In another report by Erb, et al. (8) in 1953, average decline in lactation yield was found to be about 6.4 pounds of FCM for each day cows carried calves beyond 60 days. Also, an average decline in lactation fat yield observed was 0.202 pounds for each day cows carried calves beyond 128 days. The workers recommended adjustment factors for days carried calf when production records are used for culling or replacement purposes.

Starkey, et al. (35) conducted a study on three years' data from 43 southern Wisconsin herds. They estimated the influence of days cows carried calves and calving interval on milk fat yield by multiple correlation techniques and found both traits were highly significant ($P < .01$) over all herds.

Lee, et al. (16) reported the effect of gestation on 2,364 records from Georgia data. A highly significant regression of 8.2 pounds of FCM and 0.3 pounds of milk fat was found for each day of gestation. Six percent of the variation in milk production was believed associated with gestation effects.

In 1951, Mahadevan (21) in Scotland began using 180 day production records as he believed that this record length would eliminate the influence of pregnancy which begins at a period of longer than 180 days. He suggested that the 180 day record eliminated some uncontrollable physiological effects which are encountered in the latter stages of a lactation, such as increased mammary tissue development and growth. Also, two Iowa studies (15,36), conducted in 1964 and 1967, utilized 243 day production records as the researchers were of the opinion that this record length would avoid the need for corrections for differences in the amount of gestation included in lactations. However, use of partial lactation records would not evaluate cows that have differences in persistency in late lactation.

It seems quite apparent that gestation is recognized as having an effect on production. Most researchers either allow for gestation influences or at least mention the influences or effects that might exist. Recognizing that there is a definite influence by gestation, the proper time to have a cow bred following parturition is controversial. It is a common belief among many dairymen that production level is associated with conception. In a study by Gaines (11), a conclusion was reached that high initial or maximum rate of milk production is not antagonistic to the recurrence of conception. Asdell (1) suggested that management was at fault for poor conception level. Contradictary to these findings, Lewis and

Harwood (18) and Carman (4) found production level to be antagonistic to the recurrence of conception. There is a general lack of agreement between researchers about the relationship.

Trimberger (37) concluded that results for rate of conception from first service, average number of services per conception, and average days from parturition to conception indicated that for good reproductive performance in dairy cattle, the first service should be over 50 days following parturition in normal cows with good genital health. Most common recommendations suggest breeding 60 to 90 days post partum for best reproductive performance.

VanDemark and Salisbury (41) studied 1,674 pregnancies and found that maximum breeding efficiency resulted when breeding was delayed until 100 to 120 days after parturition and efficiency decreased slightly after this period. In their study, reproductive efficiency was measured in terms of services required per conception.

Hammond and Sanders (14) suggested 100 days be used as the normal service period for maximum reproductive performance. Cows bred at this period will calve again at about two or three weeks later the next year. However, some cows may have estrus only early in lactation and waiting too long after calving may result in barren cows.

The period prior to breeding cows or the number of days cows are open has been associated with an effect on lactation also. Number of days open has been viewed as both advantageous to the individual lactation and detrimental from an economic standpoint.

Hammond and Sanders (14) speculated that cow yields may vary ± 30 percent depending upon whether the number of days open are long or short. Their reasoning was due to the fact that a close relation exists between the number of days open and the length of a cow's current lactation.

Sanders (28) studied the effect of service period or days open and suggested that additive correction factors be used to adjust for the days open period. He used 85 days as the standard period, as did Etgen (9) in a later study. This period was used since an 85 day standard would be the ideal situation if a cow was to milk 305 days, have a 60 day dry period, and calve again in exactly 12 months. Sanders studied both first lactation and later lactation animals, and observed that the lactation production curve was flatter for first lactation animals. He concluded that first lactation animals had a lower maximum yield, but suggested that they were more persistent than older animals. The effect of days open on first lactation animals differed considerably from the effect on older cows; thus, two sets of adjustment factors were believed to be warranted. The relationships were found to be linear.

Matson (22) reported on the India Military Farms research in 1929. He concluded that the essential factor governing yield, after heredity and diet, was the length of service period which precedes lactations and not which accompanies them. He suggested that a moderate shortening of service periods will raise the current average lactation yield as the dry period will be shortened and will occur while yield is still high. Matson found that animals, however, suffer in the next lactations. Also, he suggested that frequent pregnancies depress lifetime yield, while longer intervals increase lifetime yields. These conclusions are somewhat contradictary to other research findings.

In 1958, Etgen (9) studied the effect of days open on the production of 1,508 Holstein cows in several Ohio institution herds. Both linear and exponential function regressions were performed. The standard deviations for the exponential functions were much higher than those for linear values; therefore, linear regression was used throughout the data. Etgen evaluated groups as two year olds, three and four year olds, five years old and older, and all animals. Milk regression values on days open for the various groups were 5.74, 8.57, 12.20, and 8.33 pounds, respectively. Corresponding values for milk fat were 0.16, 0.30, 0.42, and 0.26 pounds. Simple correlation coefficients between days open and milk for the groups were 0.17, 0.22, 0.37, and 0.24, respectively. Corresponding values for milk fat were 0.10, 0.21, 0.36, and 0.20. Correction factors were suggested for use at the various age groups.

In 1962, Smith (30,31) of North Carolina reported on 4,385 Holsteins located in nine institution herds. He studied the relation between days open and the first 90 day production and with 305 day production. Records were analyzed as first, second or later, and all lactations. First lactation production changes were adequately accounted for by linear regression. In the other two groups, however, the regression was found to be curvilinear. Partial regression coefficients of 305 day milk production on days open adjusted for age were 17, 17, and 16 pounds for first, second or later, and all lactations, respectively. Corresponding values for milk fat were 0.5, 0.5, and 0.48 pounds. Multiplicative correction factors were computed to provide an appropriate adjustment for days open. A standard of 100 days was used as this base was between the mean and the mode and is consistent with a desirable calving interval.

Louca and Legates (19) reported on production losses due to days open. A total of 4,910 completed lactations was studied. There was an average decrease of 5.3 pounds of milk and 0.25 pounds of milk fat for each additional day open. An increase of 2.6 pounds of milk was found in first lactation data. This was believed due to higher persistency in first lactation animals. The study was analyzed from an economic standpoint with the reasoning that yield per unit of time is more important than total lactation production. It was suggested that more days open is identified with an extended late lactation period where daily production is low and fewer days open would mean a shorter period of low daily production. The main purpose of the study was to evaluate days open when examined over a period of several lactations.

Miller and Hooven (25) studied 1,004 Holstein lactation records collected over a period of 14 years. The influence of days open on yield was found to be small, accounting for zero to two percent of the variance. There was much inconsistency in days open data with the only pattern being a negative relationship with production in third lactations.

From these studies, it appears that there are conflicting results among experiments particularly between first lactation cows and older cows. Ludwick, et al. (20) suggested that younger cows tend to have persistency values about 10 percent higher than older cows. This is believed due to an adjustment to different hormones which probably functioned completely for the first time. Prolactin is the important hormone in this case because of its necessity for continued lactation. The workers speculated that a possible excess of prolactin exists in the first lactation due to the limitation of production because of udder size. With this theory, it is assumed that prolactin secretion is constant regardless of age or stage of pregnancy.

Smith and Legates (32) measured persistency by taking the ratio of the last 215 days' production to the first 90 days' production. First lactation persistency values were 1.844 and later lactation values averaged 1.588. The number of days open accounted for seven and five percent of the variation in persistency for first and later records, respectively.

Calving interval, which is a direct result of days open, also enters in as a production influence. Gaines and Palfrey (12) found that as the calving interval increases, the average yield per day tends to decrease during the current interval, and tends to increase during the following interval. They stated, however, that the relations were very irregular. Correlation values were found to be very low and negative between calving interval and current yield per day. Thus, the workers concluded that there is a small gain from a short calving interval in the current lactation, but it is lost in the following lactation.

Tyler and Hyatt (39,40) examined 2,203 records from the Ayrshire Breeder's Association. The data indicated that significantly lower milk and milk fat production occurred in cows with 10 or 11 month calving intervals when compared with cows with 12 or 13 month intervals. Significantly greater production was not obtained when 14 or 15 month or longer intervals were compared with 12 or 13 month intervals. The researchers suggested that the recommended 12 or 13 month interval be followed as longer intervals will lose, on the calendar year, milk production and the reproductive basis for the herd as a whole.

Mahadevan (21) suggested that adjustment factors be used based on the regression of 180 day milk yield on length of preceding calving interval. He found the optimum calving interval for first lactation animals to be 400 days and one year for subsequent lactations.

In 1967, Norman and Thoele (26) of Pennsylvania reported that calving interval accounted for 5.4 to 14.7 percent and 4.1 to 13.5 percent of the within herd-year-season variation in mature equivalent (ME) milk and milk fat, respectively, in first through fifth lactation records. Correction factors were derived to adjust milk and milk fat records for length of concurrent calving interval.

Speicher and Meadows (33) used the records of 4,285 Holstein cows to determine the effect of calving interval on milk production. The effect of calving interval on average daily milk production was found to be highly significant. They reported their results from an economic viewpoint and concluded that delaying conception beyond 86 days caused a decrease in average return ranging from 50 to 78 cents per day.

Heritability estimates of the discussed reproductive traits are relatively low. Dunbar and Henderson (6), using the paternal half sib method, estimated the heritability for calving interval to be zero. Legates (17) studied 2,419 calving intervals of 1,016 cows and also found calving interval heritability to be zero. Norman and Thoele (26) found that intra-herd heritability estimates for calving interval ranged from 0.02 to 0.04. Smith (30) computed heritability estimates for days open from sire components of variance and found values of 0.01, 0.05, and 0.09 for first, second or later, and all lactations, respectively. These values all suggest that there is little or no additive genetic variation in most reproductive measures; thus, selection for such characteristics would not be very effective.

MATERIALS AND METHODS

Data

Data on 33 South Dakota Holstein herds were obtained from the Iowa State Data Processing Center located at Ames, Iowa. Criteria used in the selection of herds included in the study were that herds had to have been on official test at least five consecutive years, and had to have maintained an average herd size of 35 cows or more. Under the given conditions, 34 Holstein herds qualified. One herd, however, was eliminated from the study. The South Dakota State University herd was not included since experimental projects conducted in the institution herd may cause abnormal results which are not typical of common dairy operations. The earliest record used in the study was initiated December 25, 1957, and the latest record was initiated March 9, 1968.

Twice-a-day milking (2X) was practiced in all the herds through the duration of the study. Records were eliminated if they were not at least 90 days in length. Records which were in progress were projected with the use of the factors suggested by McDaniel, et al. (23). All completed or projected records were standardized to a 305 day, 2X, ME basis using the factors established by McDaniel, et al. (24).

Days open values were all computed by subtracting a gestation length of 280 days (5,30,31,34) from the calving date occurring in the following lactation. This method was used to approximate the date of conception, as often breeding dates are not available or could have been erroneously reported or recorded. Lactation records with days open values of over 400 days were eliminated from the study, as were all records which were initiated with abortions.

After all conditions were met, there were 1,953 first lactation records and 5,412 second or later lactation records for a total of 7,365 records. Animals were divided into first and second or later lactation groups with first lactation animals classified as those animals which were 32 months of age or less on their date of calving.

Methods of Analysis

Lactation records were analyzed as first, second or later, and all records. First lactation records were analyzed separately as research indicates that first lactation records tend to have higher persistency values than later lactation records (20,28,32). Also, the first lactation is an adjustment period for the dairy animal and new stresses may have more effect on young animals.

All three groups were analyzed in the same manner. Simple linear regression was used to determine relative changes in production with unit changes in days open values. All regression analyses were computed on a within herd-year-season basis with two seasons being from November through June and from July through October. A total of 408 herd-season groups was found. A within sire basis was not used as many of the herds included in the study had missing sire data. The sire component was justifiably deleted as a comparative study by Smith (30) showed that the sire component of variance for days open was very near zero. Only linear regression was used on the data as several previous studies found the relationship to be distinctly linear (9,19,21,28). Analysis of variance was used to determine whether or not regression accounted for a significant amount of the variance.

Phenotypic correlations were calculated by the following formula:

$$r = \sqrt{\frac{(\Sigma xy)^2}{\Sigma x^2 \ \Sigma y^2}}$$

These values were calculated to measure the degree to which the observed variables varied together. Coefficients of determination values (r^2) were also calculated from the above formula on all data to determine the variance in milk and milk fat attributable to days open during the lactation.

RESULTS AND DISCUSSION

It is difficult to control all the environmental factors that may influence results in a study of this nature. By using a within herd-year-season analysis, many of these influences are diminished. One must realize, however, that heredity and environmental interactions may occur within a herd and may also affect results and their interpretation. In this study, an attempt has been made to standardize data as much as possible to obtain results which are an accurate estimate of the effect of days open on milk and milk fat production in South Dakota Holstein cows.

Table 1 consists of a summary of results obtained on all first lactation records in the study. The regression coefficients are those determined after all records were standardized to a 305 day, 2X, ME basis. The coefficients of 8.341 for milk and 0.286 for milk fat indicate that for each additional day open, the first lactation animals in this study produced an average of 8.341 pounds of milk and 0.286 pounds of milk fat during a 305 day lactation. Utilizing these values, a cow carrying a calf 205 days would be expected to produce 1,710 pounds of milk and 58.6 pounds of milk fat less than a cow which was not pregnant during the entire lactation. Correlation coefficients of 0.22 for both milk and milk fat indicate a positive correlation between days open and lactation production. The resulting coefficients of determination amount to 0.048, which suggest that 4.8 percent of the first lactation variance in milk and milk fat production can be accounted for by days open.

TABLE 1. Linear regression analysis and means of first lactation Holstein cows.

	$\bar{X}$[1]	b[2]	Sx of b[3]	r[4]	r^2[5]
Days open	107.05				
ME milk production	13,480				
ME milk fat production	475.3				
Days open with milk		8.341	0.300	0.22	0.0481
Days open with milk fat		0.286	0.030	0.22	0.0481

[1] $\bar{X}$ = mean of 1,953 records.

[2] b = simple regression coefficient.

[3] Sx of b = standard deviation of simple regression.

[4] r = simple correlation coefficient.

[5] r^2 = coefficient of determination.

A summary of results obtained on second or later lactation records is presented in Table 2. The regression coefficients of 10.123 for milk and 0.336 for milk fat indicate that for each additional day open, the second or later lactation animals in this study produced an average of 10.123 pounds of milk and 0.336 pounds of milk fat during a 305 day lactation. Comparing these values over an extended time period reveals that a cow carrying a calf 205 days would be expected to produce 2,075 pounds of milk and 68.9 pounds of milk fat less than a cow which was not pregnant during the entire lactation. Simple correlation coefficients of 0.24 for milk and 0.22 for milk fat indicate a positive correlation between days open and the milk production traits. Coefficient of determination values of 0.058 for milk and 0.050 for milk fat suggest that 5.8 percent of the variance in second or later lactation milk production and 5.0 percent of the corresponding variance in milk fat production can be accounted for by days open.

Contrasting regression values for first and second or later lactations, it is evident that there is considerable difference between the two age groupings. In the second or later lactation group, the higher regression value obtained suggests that gestation has a greater effect on cows beyond their first lactation. This perhaps indicates that first lactation animals are more persistent in production, as was pointed out by other research workers (9,20,32).

In Table 3, a summary of results obtained on all animals in the study, regardless of age, is presented. The regression coefficients

TABLE 2. Linear regression analysis and means of second or later lactation Holstein cows.

	$\bar{X}$[1]	b[2]	Sx of b[3]	r[4]	r^2[5]
Days open	106.57				
ME milk production	13,430				
ME milk fat production	469.5				
Days open with milk		10.123	0.180	0.24	0.0580
Days open with milk fat		0.336	0.020	0.22	0.0505

[1] $\bar{X}$ = mean of 5,412 records.

[2] b = simple regression coefficient.

[3] Sx of b = standard deviation of simple regression.

[4] r = simple correlation coefficient.

[5] r^2 = coefficient of determination.

TABLE 3. Linear regression analysis and means of all Holstein lactations.

	$\bar{X}$[1]	b[2]	Sx of b[3]	r[4]	r^2[5]
Days open	106.70				
ME milk production	13,443				
ME milk fat production	471.0				
Days open with milk		9.697	0.240	0.24	0.0561
Days open with milk fat		0.324	0.014	0.22	0.0498

[1]$\bar{X}$ = mean of 7,365 records.

[2]b = simple regression coefficient.

[3]Sx of b = standard deviation of simple regression.

[4]r = simple correlation coefficient.

[5]r^2 = coefficient of determination.

of 9.697 for milk and 0.324 for milk fat indicate that for each additional day open, the average cow in this study produced 9.697 pounds of milk and 0.324 pounds of milk fat during a 305 day lactation. Correlation values of 0.24 for milk and 0.22 for milk fat indicate a positive correlation between days open and the production traits. Coefficient of determination values of 0.056 for milk and 0.050 for milk fat production indicate 5.6 and 5.0 percent of the variance in milk and milk fat production, respectively, is accounted for by days open.

Analysis of variance in all three of the groupings indicated that a highly significant ($P < .01$) amount of the variance observed could be accounted for by linear regression or a highly significant reduction in variability of milk and milk fat could be attributable to the variability in days open.

Figures 1 and 2 are graphical presentations of the regression equations of milk and milk fat production on days open for first, second or later, and all lactations.

Differences ranging from 1,710 to 2,075 fewer pounds of milk and 58.6 to 68.9 fewer pounds of milk fat for carrying a calf an additional 205 days during a 305 day lactation appear quite important when evaluating an individual lactation record. However, leaving a cow open an additional time period to gain production during a single lactation would not be advantageous in terms of lifetime net return. The practice of some breeders to delay breeding to make more impressive records can be a problem that artificial insemination organizations and dairymen may encounter when purchasing breeding cattle. This

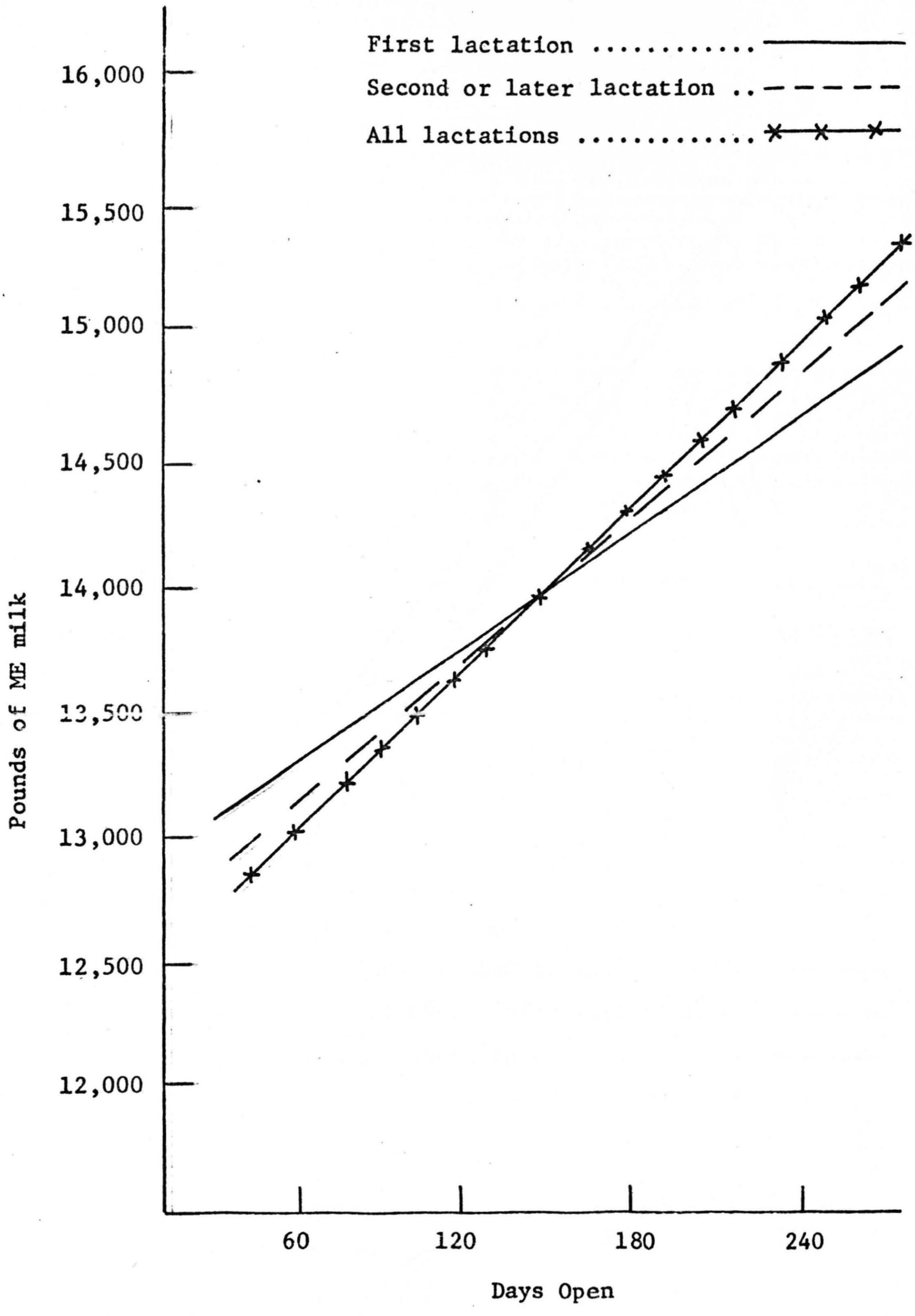

Figure 1. Regressions of milk production on days open.

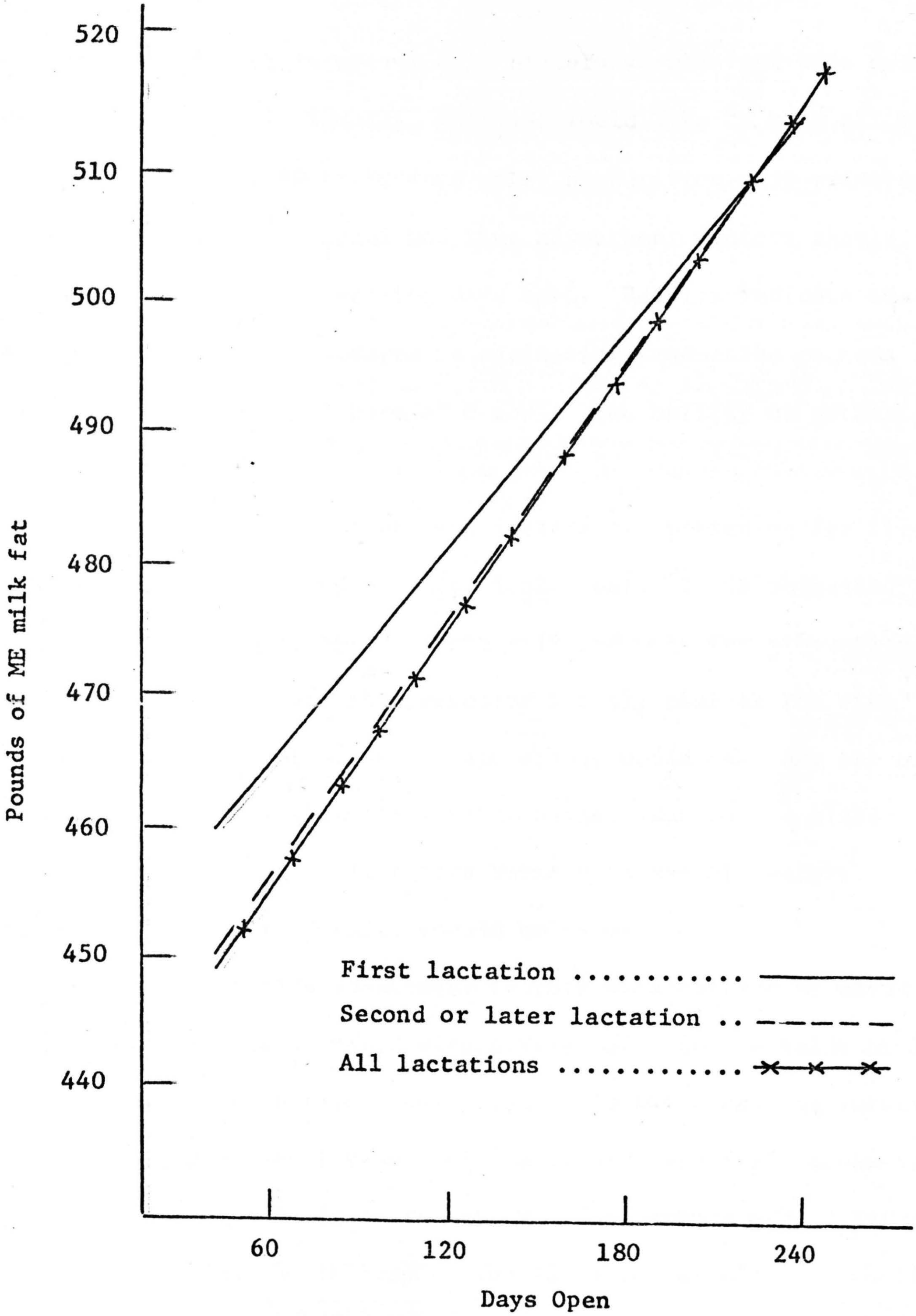

Figure 2. Regressions of milk fat production on days open.

environmental factor is not usually closely scrutinized when evaluating potential purchases. Ideally, dairymen would like to have all cows in their herds bred 60 to 90 days after parturition. In practice, however, this does not occur and thus adjustment factors should be valuable to correct for varying days open. Results indicate that days open should be considered in evaluating production records so that a more accurate estimate of a cow's true ability or potential is represented.

In Tables 4 and 5, adjustment factors are presented for first lactations and for second or later lactations. It is suggested that these factors are adequate for both milk and milk fat production adjustment. Factors are not presented for all cows as the wide differences in production at the age groups would make one set of factors not as applicable for general usage. Due to the higher persistency of the first lactation animals, a set of factors, independent of older animals, should be used.

The multiplicative adjustment factors were derived by using 100 days open as the standard with a value of 1.00. A value of 100 days open was used so that a normal 12 to 13 month calving interval would result, and also because this value was relatively close to the mean days open of animals in the study. The factors were determined by first utilizing the regression equations to calculate production at 10 day intervals. These production values were divided by the 100 days open production value and the resulting quotient used as the adjustment factor. These factors may be applied best to Holsteins,

TABLE 4. Factors for adjusting 305 day production for days open in first lactation records.

Days open	Factor
30	1.04
40	1.04
50	1.03
60	1.02
70	1.02
80	1.01
90	1.01
100	1.00
110	0.99
120	0.99
130	0.98
140	0.98
150	0.97
160	0.96
170	0.96
180	0.95
190	0.95
200	0.94
210	0.94
220	0.93

TABLE 5. Factors for adjusting 305 day production for days open in second or later lactation records.

Days open	Factor
30	1.06
40	1.05
50	1.04
60	1.03
70	1.02
80	1.02
90	1.01
100	1.00
110	0.99
120	0.98
130	0.98
140	0.97
150	0.96
160	0.96
170	0.95
180	0.94
190	0.94
200	0.93
210	0.92
220	0.92

but it would seem that breed differences in such gestation effect would be relatively small, if any differences would be observed at all. Therefore, it is suggested that these factors would be reasonably accurate for most breeds. It may be, however, that the persistency value may differ from breed to breed so that the age groupings suggested might not directly apply to some breeds.

It is believed that these given adjustment factors should be a valuable aid in more accurately evaluating production records. These factors should be an improvement on early sire provings where relatively few daughters are available. As previously mentioned, the evaluation of potential breeding cattle by dairymen and artificial breeding organizations could also be aided. Research workers might also benefit from using such factors. Some studies, such as nutrition trials, often have small animal numbers represented and the days open effect might influence results and conclusions considerably. By utilizing an adjustment factor, possible misleading conclusions may be diminished.

Although adjustment factors for all lactations are not presented, the factors derived for them are nearly identical to those presented by Smith (30). Therefore, it appears that linear regression is as adequate in showing production-days open relationships as is the curvilinear regression used by Smith.

Heritability estimates were not determined as only 891 daughter-dam combinations existed in the data and many of these cows had missing sire information and therefore, a within sire-herd regression of offspring on dam was not feasible because of the lack of numbers. However, from the review of literature, heritability of days open could be expected to be extremely low and therefore days open would be relatively unimportant if dairymen were to use this trait in selection. The low heritability would make the genetic advance due to selection extremely low.

SUMMARY AND CONCLUSIONS

This study was undertaken to determine the relationships which exist between days open and 305 day ME milk and milk fat production.

The data were grouped and analyzed as first lactations, second or later lactations, and all lactations. There were 1,953 first lactation records, 5,412 second or later lactation records, and a total of 7,365 records from 33 South Dakota Holstein herds. The time span in the study was from December 25, 1957, when the first record was initiated, until March 9, 1968, when the last record was initiated.

A within herd-year-season regression analysis on the data revealed regression values for milk ranging from 8.341 to 10.123 and regression values for milk fat ranging from 0.286 to 0.336 Simple correlation coefficients between milk production and days open ranged from 0.22 to 0.24, and between milk fat production and days open ranged from 0.22 to 0.23. The amount of variance in milk production accounted for by days open ranged from 4.8 to 5.8 percent, and the variance in milk fat production accounted for by days open ranged from 4.8 to 5.0 percent.

The average cow in this study was open 107 days prior to conception and produced, on an ME basis, 13,443 pounds of milk and 471.0 pounds of milk fat during the concurrent 305 day lactation.

Differences in production for those animals conceiving at 100 days after parturition and those not conceiving during the

305 day lactation are quite large and therefore, multiplicative adjustment factors are suggested for use in correcting for the number of days open in a lactation.

Conclusions drawn from the study are:

(1). Increased days open tend to increase production within a given lactation.

(2). First lactation animals in this study were more persistent in production than older animals.

(3). The correlation between days open and production traits in this study were positive, but not of great magnitude.

(4). Days open account for 4.8 to 5.8 percent of the variation in milk and milk fat production of the cows in this study.

(5). Multiplicative adjustment factors appear warranted, and should be valuable for correcting for the number of days open during a lactation.

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